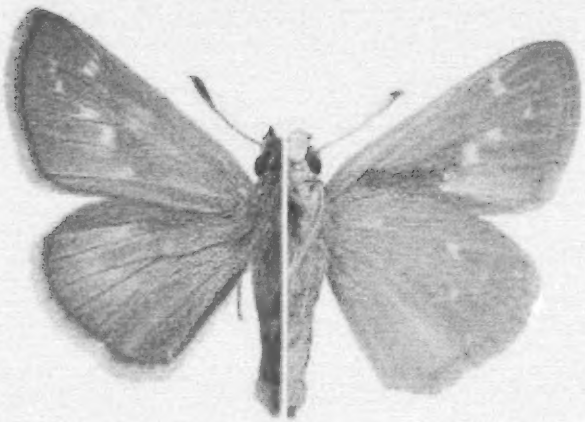
COSEWIC
Assessment and Status Report

on the

Dakota Skipper
Hesperoa dacotae

in Canada



THREATENED
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC 2003. COSEWIC assessment and status report on the Dakota skipper *Hesperia dacotae* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 35 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Production note: COSEWIC would like to acknowledge Reginald P. Webster for writing the status report on the Dakota skipper *Hesperia dacotae* in Canada, prepared under contract with Environment Canada, overseen and edited by Theresa Fowler, the COSEWIC Arthropods Species Specialist Co-chair.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur l'hespérie du Dakota (*Hesperia dacotae*) au Canada.

Cover illustration:
Dakota skipper — female of *Hesperia dacotae* showing dorsal and ventral views (Photo by Chris McQuarrie & R.P. Webster).

©Her Majesty the Queen in Right of Canada 2004
Catalogue No. CW69-14/358-2004E-PDF
ISBN 0-662-36651-4
HTML: CW69-14/358-2004E-HTML
0-662-36652-2

Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – November 2003

Common name
Dakota Skipper

Scientific name
Hesperia dacotae

Status
Threatened

Reason for designation
This butterfly is dependent on native tall-grass and mixed-grass prairie, a habitat that has suffered enormous historic losses, and the butterfly's populations have likely undergone similar declines. Current remnants of native prairie are generally not highly threatened as they are mostly unsuitable for agriculture but some habitat loss and fragmentation continue. The butterfly is very sensitive to conversion of prairie remnants to cropland, spring and summer haying, heavy grazing, controlled burns and increased pressures to drain natural sites. Although the current population of this butterfly numbers 28,500 – 40,500 individuals, these occur in only three or four disjunct populations. The long-term persistence of the butterfly is dependent on appropriate management of its habitat, most of which is privately owned.

Occurrence
Manitoba and Saskatchewan

Status history
Designated Threatened in November 2003. Assessment based on a new status report.

COSEWIC
Executive Summary

Dakota Skipper
Hesperia dacotae

Species information

The Dakota Skipper, *Hesperia dacotae*, is a member of the family Hesperidae (Skippers), subfamily Hesperiinae (Branded Skippers), and the Order Lepidoptera (Butterflies and Moths). No subspecies are recognized.

The adult Dakota Skipper has a 21 to 29 mm wingspan. Males and females differ in coloration. Males are tawny orange with a diffuse brownish border on the upper side of the wings and an elongated dark mark (called the brand) on the front wing. The underside is yellowish orange with a poorly developed band of paler spots arranged in a semicircle. Females, which lack the brand, range from buff to brown with varying degrees of orange over-scaling on the upper side. There are usually several small, translucent, whitish spots on the upper side of the front wing. The under side of the wings is yellowish brown with a semicircle of ill-defined whitish spots on the hind wing.

The eggs are hemispherical in shape and only about 1.2 mm in diameter. The full-grown caterpillars are about 20 mm in length. They are light brown to flesh colored with no distinctive color patterns.

Distribution

The Dakota Skipper currently occurs in isolated populations from southern Manitoba and southeastern Saskatchewan southward through eastern North and South Dakota to western Minnesota. In Canada, it persists in only three or four disjunct populations.

Habitat

In Canada and the United States, the Dakota Skipper is an obligate resident of native tall-grass prairies and upland dry mixed-grass prairies.

In Manitoba, all known localities of the Dakota Skipper are associated with tall-grass prairies that have bluestem grasses and abundant nectar sources such as Harebell, Black-eyed Susan and Wood Lily. Indicator plants for the presence of the Dakota Skipper in Manitoba are Smooth Camas (sometimes called Alkali Grass), Wood

Lily, Harebell, and Black-eyed Susan. With few exceptions, the Dakota Skipper was always present in prairies with these four plants. Smooth Camas is an extremely reliable indicator for the presence of the Dakota Skipper and is easier to detect than the insect. Its flowering period coincides almost perfectly with the Dakota Skipper's flight season in Manitoba. However, the biology of the Dakota Skipper is completely independent of this plant.

In Saskatchewan, the Dakota Skipper is found in upland mixed-grass prairies, most often on prairie hills above river systems. The mixed-grass prairies are dominated by bluestem and needle grasses. Purple Coneflower is a characteristic plant on this kind of prairie and is one of the important nectar sources for adult skippers.

Biology

Each life history stage of the Dakota Skipper has its specific resource requirements. There is only one adult generation per year. Adults are active for only about a three- to five-week period, usually from late June to mid- or late July. Adults may live as long as three weeks.

Adult females usually mate within one or two days after emerging from the chrysalis. Females begin laying eggs shortly after mating. Eggs are usually laid singly on the undersides of leaves on caterpillar host grasses or on plants close to caterpillar host grasses. Dakota Skipper caterpillars eat a variety of grass species, all being species characteristic of native prairie habitats.

Caterpillars go through six or seven stages, or instars, before forming a chrysalis. During either the fourth or fifth instar, the larvae stop feeding (usually in late September) and enter an obligatory diapause (a form of hibernation). They pass the winter in this stage, resume feeding in spring, complete development during June, and form a chrysalis. Adults emerge two and a half weeks later.

Population sizes and trends

Since the 1850s, over 99% of the tall-grass prairie habitat of the Dakota Skipper in North America has been converted to agricultural uses.

In Canada, only about 50 km^2 of the original 6,000 km^2 of tall-grass prairie remain. The distribution of the Dakota Skipper is now highly fragmented, and the species occurs in only two isolated areas in Manitoba and in one small area in southeastern Saskatchewan. The remaining stronghold for the species in Canada is in the inter-lake region between Lake Manitoba and Lake Winnipeg where the Dakota Skipper is still locally common.

Limiting factors and threats

The Dakota Skipper lives only in tall-grass and upland mixed-grass prairie habitats. It is extremely susceptible to any disturbances, such as grazing, prescribed burning, and row crop agriculture, that alter the floral and structural components of its preferred habitat. Key adult and caterpillar food resources must be present in the habitat for the long-term survival of this insect. Nectar is extremely important for adult skippers. It provides an energy source for adults and allows females to attain maximal life-time egg production. An even more critical resource provided by nectar may be water, without which adults will die within hours during hot, dry weather. Both the flowers preferred by adults for nectaring and the species of grasses preferred by caterpillars for food are characteristic of native prairie habitats. These plants rarely occur in agricultural habitats making them completely unsuitable for the survival of the skipper.

Special significance of the species

The Dakota Skipper is one of a very small group of specialist butterflies that occur only in native tall-grass and mixed-grass prairie habitats in Canada. This species persists in a series of isolated populations in the United States and Canada. The loss of this skipper from Canada would represent the loss of a significant component of the endangered prairie ecosystem.

Existing protection or other status designations

The Dakota Skipper currently has no legal protection in Canada at the national level. However, the Dakota Skipper is listed as endangered by the Province of Manitoba under its Endangered Species Act. There is currently no legal protection in Saskatchewan. Globally, the World Conservation Union (IUCN) classifies the Dakota Skipper as vulnerable. In the United States, the Dakota Skipper receives no federal protection under the U.S. Endangered Species Act. This skipper is listed as endangered in Iowa, threatened in Minnesota, and has no legal protection in either North or South Dakota.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species and include the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal organizations (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership, chaired by the Canadian Museum of Nature), three nonjurisdictional members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The committee meets to consider status reports on candidate species.

DEFINITIONS (AFTER MAY 2003)

Species	Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

Environment Canada | Environnement Canada

Canadian Wildlife Service | Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Dakota Skipper

Hesperia dacotae

in Canada

2003

TABLE OF CONTENTS

SPECIES INFORMATION 4
Name and classification 4
Description 4
DISTRIBUTION 6
Global range 6
Canadian range 6
HABITAT 8
Habitat requirements 8
Trends 10
Protection/ownership 12
BIOLOGY 13
General 13
Adult activity period 13
Adult food resources 13
Courtship behaviour 14
Oviposition behaviour and fecundity 15
Larval resources 16
Larval development 16
Larval behaviour 17
Natural mortality factors 17
Population dynamics 18
Movements/dispersal 18
Interspecific interactions 18
Adaptability 19
POPULATION SIZES AND TRENDS 19
LIMITING FACTORS 20
Nectar flowers 21
Larval host plants 21
Mating activity sites 21
THREATS 22
Conversion of habitat to non-grassland 22
Grazing 22
Haying 22
Controlled burning 23
Succession 24
Exotic species 25
Habitat fragmentation 25
Collection of natural history specimens 26
Other threats 26
SPECIAL SIGNIFICANCE OF THE SPECIES 26
EXISTING PROTECTION OR OTHER STATUS 26
SUMMARY OF STATUS REPORT 27
TECHNICAL SUMMARY 28

ACKNOWLEDGEMENTS 31
LITERATURE CITED 31
BIOGRAPHICAL SUMMARY OF THE REPORT WRITER 33
AUTHORITIES CONSULTED 34
COLLECTIONS EXAMINED 35

List of figures

Figure 1. Male and female of *Hesperia dacotae* showing dorsal and ventral views. 5
Figure 2. Global range of *Hesperia dacotae* 6
Figure 3. Canadian range of *Hesperia dacotae* 7
Figure 4. Habitat of *Hesperia dacotae* 9

SPECIES INFORMATION

Name and classification

Hesperia dacotae (Skinner 1911), or the Dakota Skipper, is a member of the family Hesperiidae, the Skippers, subfamily Hesperiinae, the Branded Skippers, and the Order Lepidoptera, the Butterflies and Moths. No subspecies are recognized. This skipper was at one time considered to be a subspecies of *Hesperia sassacus* Harris which occurs in southeastern and parts of central Manitoba, eastward to the Maritimes and the eastern U.S.A. (Layberry et al. 1998).

Description

H. dacotae is one of the smaller *Hesperia* species with a 21 and 29 mm wingspan (Layberry et al. 1998).

In males, the upper side of the wings is tawny orange with a diffuse brownish border on the forewing (Figure 1). There is considerable individual variation in the intensity and extent of this border. The forewing has a dark elongate mark, called the stigma. This stigma has a black interior felt patch and contains androconial scales (specialized scales on the wings of males that produce a pheromone involved in courtship). The underside of the wings is brownish orange, with a poorly developed semicircle of paler spots (macular band) on the hind wing. In some individuals these spots are completely obscured.

Females are also variable in coloration and range from buff to brown above with varying degrees of orange over-scaling on the anterior portion of the front wing and basal areas of the hind wing (Figure 1). There are several small, translucent, whitish (hyaline) spots on the front wing. The size of these spots varies in individuals. Females do not have a stigma on the front wing. The macular band on the grayish to yellowish brown underside of the wings is usually poorly defined with ill-defined whitish spots. Excellent illustrations of the adults are given in Layberry et al. (1998) (Plate 2, figures 21-23) and in Howe (1975) (Plate 89, figures 23-24).

Male *H. dacotae* may be confused in the field with males of prairie populations of *Polites mystic* (W.H. Edwards). The coloration on the underside of the two species is very similar, and the two species often co-occur in Canada. However, the stigma of *P. mystic* is broader and shaped differently.

The egg (basal diameter 1.21 mm, height 0.95 mm) is hemispherical and has a smooth surface. It is gleaming, semi-translucent white, becoming darker with age (Dana 1991).

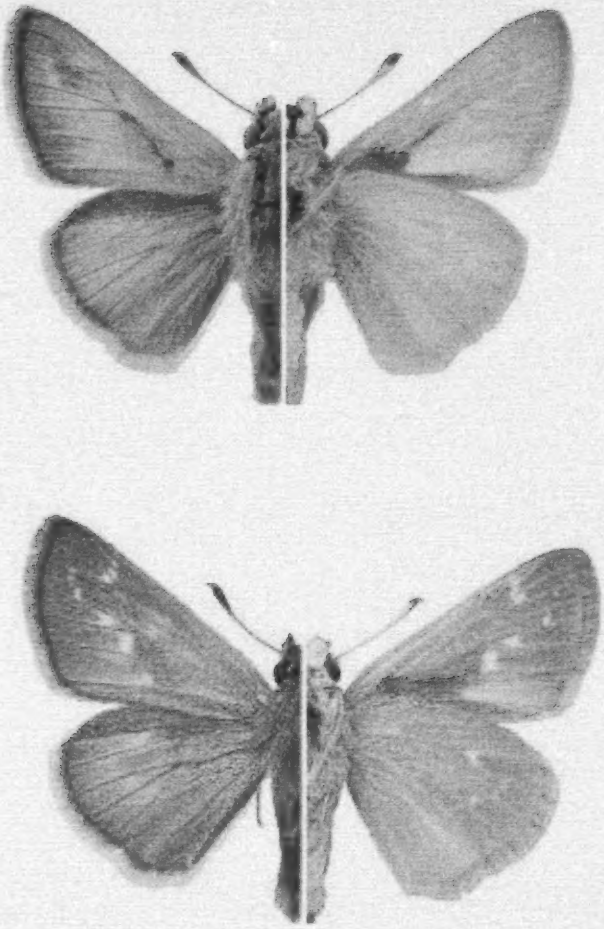


Figure 1. Male (top) and female (bottom) of *Hesperia dacotae* showing dorsal (left) and ventral (right) views (Photo by Chris McQuarrie & R.P. Webster).

A technical description of the mature larvae of *H. dacotae* is given in McCabe (1981). Mature larvae range from 19 to 22 mm in length. The head is 2.80-3.00 mm wide. The larvae of this species are distinguished from the larvae of other *Hesperia* by the presence of pits on the ventral portion of the head capsule. In all other species of *Hesperia*, the ventral surface of the head capsule is unpitted (McCabe 1981). The head of *H. dacotae* caterpillars is pitted throughout. The prothoracic shield, thoracic legs, and spiracles are black. The remainder of the body integument is minutely granular and light brown to flesh colored. The underside of the seventh and eight abdominal segments of last instar larvae is covered with white wax (McCabe 1981). The pupa was not described. Detailed drawings showing the structural features of the larva are given in Figures 1-6 in McCabe (1981).

DISTRIBUTION

Global range

H. dacotae formerly occurred in wet-mesic tall-grass to dry-mesic mixed-grass prairies from southern Manitoba southeastward in a broad band through North Dakota, eastern South Dakota, western Minnesota, Iowa and northern Illinois (McCabe 1981, Opler and Krizek 1984, Royer and Marrone 1992, Cochrane and Delphey 2002). The species is now limited to 56 sites (of which 40 are within 10 complexes connected by dispersal) in Minnesota, 48 sites (of which 32 are in 5 complexes that are likely connected by dispersal) in eastern South Dakota, 32 sites (of which 17 are within two complexes connected by dispersal) in North Dakota, 19-20 sites in Manitoba and three sites in extreme southeastern Saskatchewan (Hooper 2003, Cochrane and Delphey 2002) (Figure 2).

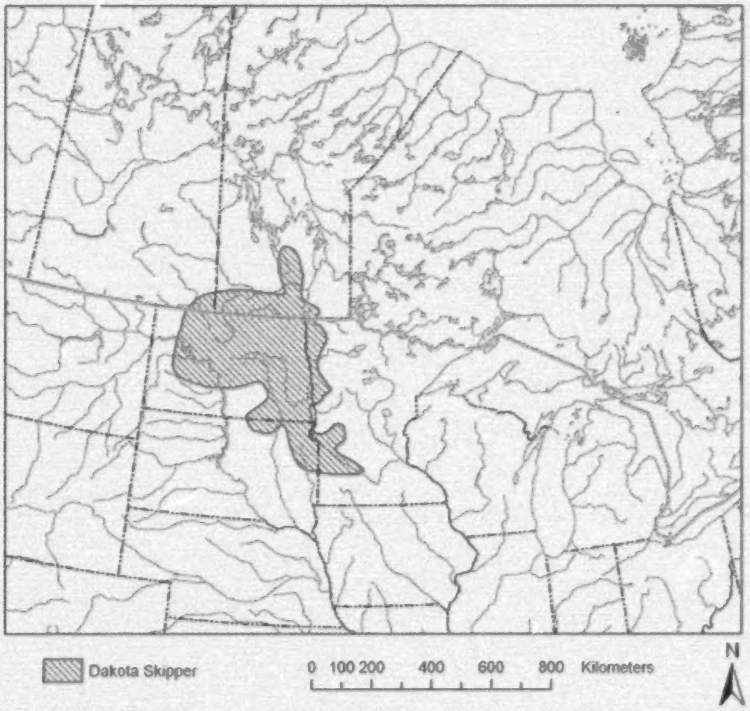


Figure 2. Global range of *Hesperia dacotae*.

Canadian range

In Canada, *H. dacotae* is restricted to southern Manitoba and extreme southeastern Saskatchewan (Figure 3) where its current range is highly fragmented.

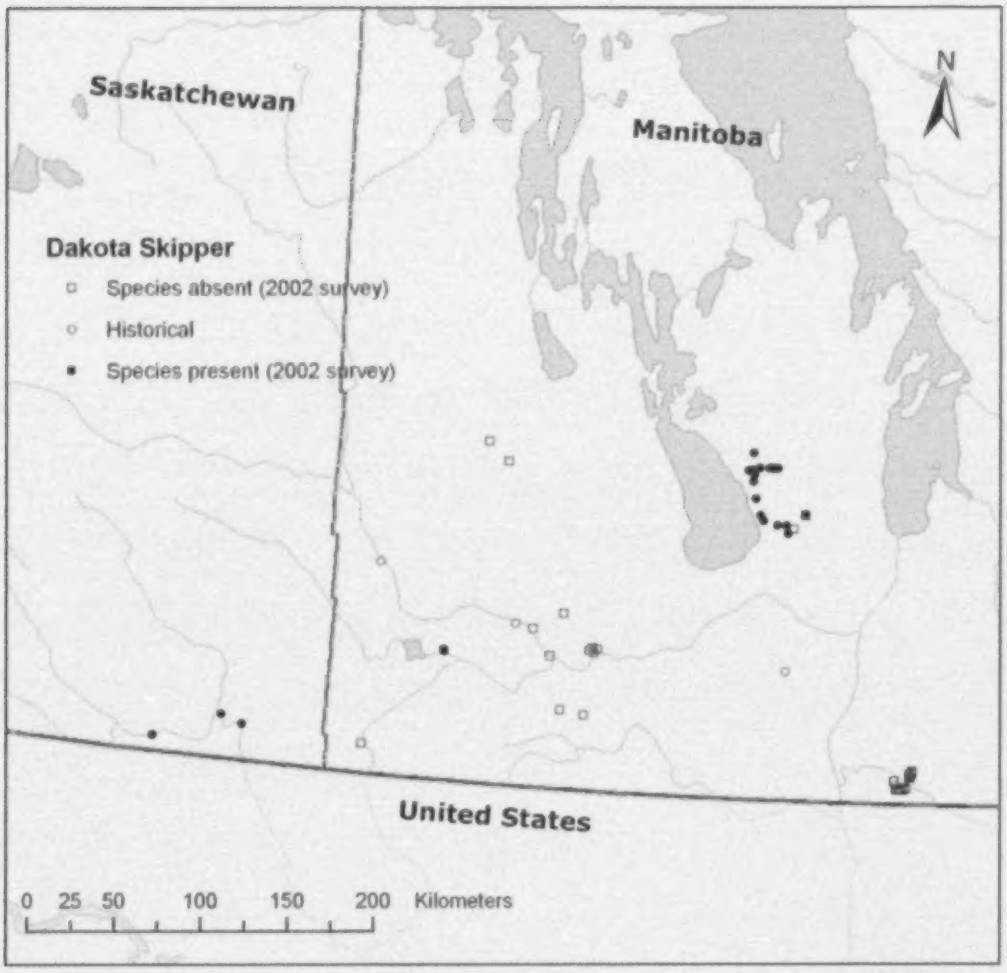


Figure 3. Canadian range of *Hesperia dacotae*.

In Manitoba, *H. dacotae* has been found at 35 localities represented by seven isolated populations or population centres (CNC collection database; Manitoba Conservation, Biological and Conservation Data System data). This skipper is currently known to persist at only two of these population centres. The first and by far the largest population centre occurs in the inter-lake region between Lake Winnipeg and Lake Manitoba. *H. dacotae* has been found at 19 localities in this region, near Eriksdale, Lundar, Inwood, and St. Laurent. In 2002, *H. dacotae* was found at 17 of these localities. Because of habitat loss in areas between populations, the 17 localities are probably now part of more than one meta-population. The second centre was near Winnipeg and includes a historical record from the 1930s but no recent records. The third population used to occur southwest of Winnipeg near Fannystelle, but it no longer exists. The fourth

population occurs in southeastern Manitoba and includes seven sites near Tolstoi, Gardendon, and Stuartburn. These sites are close to each other and are (or were) likely connected by dispersal and thus represent one population complex. *H. dacotae* was not found at any of these sites during 2002. The fifth population center was near Miniota, presumably on prairie hills above the Assiniboine River, where *H. dacotae* was last collected in 1944. A sixth population center occurs in southwestern Manitoba near Griswold (Sifton) and Brandon. *H. dacotae* was found at 2 sites near Griswold during 2002. *H. dacotae* was collected near Brandon in 1950, but no prairie habitat was found in the Brandon area during 2002, and this population is presumed extirpated.

In Saskatchewan, *H. dacotae* has been found at three sites (one of which consists of two localities that are close together) near Oxbow, Roche Percee and Glen Ewen above the Souris River. The Saskatchewan sites were discovered in 2001 and 2002 (Hooper 2003). It is not known if the populations at these three sites are connected by dispersal. Because of their recent discovery, there is no information on how these populations have changed over time or if additional populations once occurred in the area.

HABITAT

Habitat requirements

In Canada, *H. dacotae* is an obligate resident of two main types of prairie: low, wet-to-mesic tall-grass/bluestem prairie and upland, dry-mesic mixed-grass (bluestem) prairie. In Manitoba, all known extant populations of *H. dacotae* are associated with the wet-to-mesic tall-grass prairie (Figure 4). In Saskatchewan, *H. dacotae* is found in upland dry-mesic mixed-grass prairie (Figure 4).

Most of the wet-mesic tall-grass prairie sites in Manitoba vary from small (1.0 ha) to large (400 ha or more) openings among aspen or Bur Oak, *Quercus macrocarpa* Michx., groves. All these prairies are characterized by having low relief (at most one or two metres), and most have alternating wetter (lower) and drier (higher) sections, each with a distinctive plant community. At many sites, the drier sections of the prairies are distributed in a series of elongated patches (often less than 1.0 ha) among the wetter, lower areas of the prairie. The lower, wetter areas are often dominated by species such as Tufted Hair Grass, *Deschampsia caespitosa* (L.) Beauv., Redtop, *Agrotis stolonifera* L., various Sedges, *Carex* species, Rushes, *Juncus* species, and Mat Muhly, *Muhlenbergia richardsonis* (Trin.) Rydb. (Catling and Brownell 1987, Catling and Lafontaine 1986). Spike Rushes, *Eleocharis* species, occurred at some sites. The endangered Western Prairie Fringed Orchid, *Platanthera praeclara* Sheviak and Bowles, and the Small White Lady's Slipper, *Cypripedium candidum* Willd., were present in the prairies near Tolstoi. The higher, drier areas are often dominated by bluestem grasses, like Little Bluestem, *Andropogon scoparius*, Big Bluestem, *A. gerardii* Vitman, Prairie Dropseed, *Sporobolus heterolepis* A. Grey, and various forbs, such as Wood Lily, *Lilium philadelphicum* L., Smooth Camas or Alkali Grass, *Zigadenus elegans* Pursh, Harebell, *Campanula rotundifolia* L., and Black-eyed Susan, *Rudbeckia serotina* Nutt. Shrubby Cinquefoil,

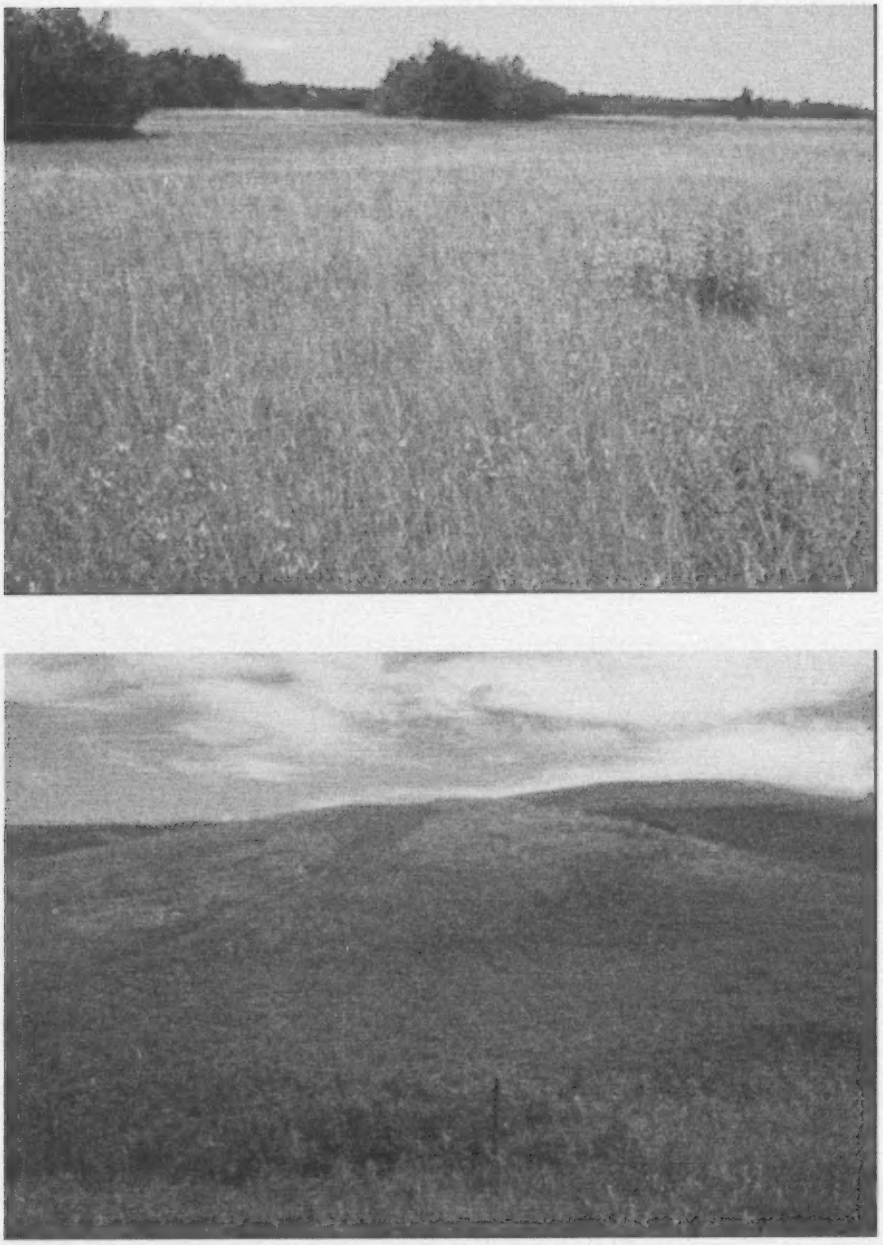


Figure 4. Habitat of *Hesperia dacotae*. Mesic Tall-grass/bluestem prairie near Lundar, Manitoba (top) and upland dry-mesic mixed-grass (bluestem) prairie near Oxbow, Saskatchewan (bottom) (Photos by R.P. Webster).

Pentaphylloides floribunda (Pursh), was also present at many of the wet-mesic prairie sites. *Z. elegans* is considered to be a calciphile and requires a soil pH above 7.0, indicating that the soils of these prairies are alkaline (Sheviak 1974). At most sites, *H. dacotae* was generally found only on the higher, drier sections (mesic) of the prairie where bunch grasses, such as *A. scoparius,* were common. Detailed descriptions of the plant communities of the prairies near Tolstoi are given in Catling and Brownell (1987) and Catling and Lafontaine (1986).

Many of the sites in Manitoba with healthy populations of *H. dacotae* are being used as hay fields. The plant community does not appear to be adversely affected by mowing. Indeed, *H. dacotae* appears to be more common on some of the mowed sites than on idle (not mowed) areas. The mowed sites can be distinguished from un-mowed sites (during the flight season of *H. dacotae*) by the absence of standing dead grass and low numbers of shrubs, often extensive areas with shorter bunch grasses (bluestem grasses), and abundant and readily observable nectar flowers. Small shrubs such as *P. floribunda* occur along the margins of the hayed prairies and often on un-mowed prairies.

Indicator plants for the presence of *H. dacotae* in wet-mesic tall-grass prairie in Manitoba are *L. philadelphicum*, *Z. elegans*, *C. rotundifolia* and *R. serotina.* With the exception of the prairies near Tolstoi and Stuartburn, *H. dacotae* was present at nearly all sites where all four of these plant species were present. *H. dacotae* was rarely found at sites without these four species (one site had only three of the species). In North Dakota, McCabe (1981) rarely found *H. dacotae* at sites without *Z. elegans* and considers *Z. elegans* as an extremely reliable indicator of *H. dacotae* habitat. This plant is much easier to detect than the insect, and its flowering period coincides almost perfectly with the flight season of the skipper (McCabe, pers. com., 2002). However, the life history of *H. dacotae* is completely independent of this plant (McCabe 1981).

The upland, dry-mesic mixed-grass prairie near Oxbow, Saskatchewan occurs on ridges and hillsides above the Souris River. This prairie type is dominated by bluestems, such as *A. scoparius,* and needlegrasses, *Stipa* spp. One of the characteristic plant species on this kind of prairie is Purple Coneflower, *Echinacea angustifolia* (DC.) Heller. *H. dacotae* was most common on the ridge tops and hillsides near stands of *E. angustifolia.*

Trends

The historical distribution of *H. dacotae* in North America will never be precisely known because much of the tall-grass and mixed-grass prairie habitat had been converted to row crop agriculture or severely degraded by overgrazing on unplowed prairies before any surveys for this and other prairie insects were initiated. At one time, there were approximately 34,000,000 ha (340,000 km^2) of tall-grass prairie in North America (Samson and Knopf 1994). Much of this habitat was lost between 1850 and 1920. Now, only about 500,000 ha are left, a decline of over 99%. Mixed-grass prairies have experienced similar losses (Samson and Knopf 1994).

In Manitoba, 600,000 ha of tall-grass prairie once existed (Samson and Knopf 1994). Now, only about 5,000 ha (this includes sites that are under a late fall mowing regime) are left, a decline of 99.5%. An even greater loss of mixed-grass prairies has taken place in Manitoba. In Saskatchewan, nearly 82% of the mixed-grass prairie habitat has been lost (Samson and Knopf 1994).

It is not known if *H. dacotae* formerly occurred throughout the tall-grass and mixed-grass prairies prior to their destruction. However, genetic distances among several widely separated populations of *H. dacotae* in the southern portion of the species' range indicate that these populations were connected in recent history (Britten and Glassford 2002). Presumably, *H. dacotae* populations have declined in proportion to the loss of tall- and mixed-grass prairie habitats in Canada and the United States. Most populations of *H. dacotae* in North America are now highly fragmented and restricted to a few remnant prairies (Cochrane and Delphey 2002).

Prior to 2001, *H. dacotae* was known from 18 sites, represented by six isolated population centres (CNC collection database; Manitoba Conservation, Biological and Conservation Data System data). This skipper was found at only two of these population centres during 2002. It appears to have been lost from former sites near Winnipeg (1933), Fannystelle (1991), Brandon (1950), and Miniota (1944). However, there is a remote possibility that populations could persist in the vicinity of Miniota if undisturbed, dry-mesic mixed-grass prairie remnants still exist along the Assiniboine River. Little prairie habitat exists near Winnipeg, and *H. dacotae* probably no longer exists there. The prairie near Fannystelle was converted to an agricultural field some time after 1991 (this site was a flax field in 2002). No prairie habitat was located near Brandon, and it can be assumed that this population has been extirpated. *H. dacotae* was present in low numbers in the 2,200-ha prairie complex in the Tolstoi/Stuartburn area of southeastern Manitoba as recently as 2000 (Britten, pers. com., 2002). No adults were observed at any of the 19 sites (including the seven former sites) surveyed during 2002 (Webster 2002). It is possible that *H. dacotae* may now be extirpated from this prairie complex. However, additional survey effort is required to confirm this.

H. dacotae is still locally common in the inter-lake region between Lake Manitoba and Lake Winnipeg. In 2002, *H. dacotae* was found at 17 sites from Eriksdale south to Lundar and St. Laurent, and east to Inwood. In 2002, *H. dacotae* was found at all but one of the five formerly known sites, and eleven new sites were located in this region. A number of these new sites had extensive prairie habitat (200 ha or more) and fairly high density (25 adults per ha) populations of *H. dacotae*. Many were under a late fall mowing regime, but appeared to have healthy populations of *H. dacotae*. Most of the sites surveyed during 2002 were adjacent to major roads or highways. A significant number of additional populations probably exist in the intervening areas away from these roads. Additional survey effort is required to determine how many additional populations exist and to better estimate the abundance and total area of occupancy of this skipper at all sites. However, many prairies in the region have been severely disturbed by over-grazing, and some appear to have been plowed and converted to hay fields. It is not known how many native prairies have been lost in recent years in this region.

A healthy population of *H. dacotae* is still present south of Griswold. This site was first discovered in 1991. This wet-mesic bluestem/tall-grass prairie complex is under a late fall mowing regime and supports the only population of *H. dacotae* currently known from western Manitoba. A small (20 ha) wet-mesic bluestem/tall-grass prairie under a late season mowing regime was located just west of Baldur. *H. dacotae* was not observed, but the habitat appears to be ideal for this skipper. The presence of this prairie suggests that additional sites for *H. dacotae* may exist in the southwestern quarter of Manitoba.

Three populations of *H. dacotae* were discovered in Saskatchewan during 2001 and 2002, all on or near prairie hills overlooking the Souris River (Hooper 2003). A portion of the habitat near Oxbow was lost, presumably when some of the prairie was converted to a golf course in recent years. Because these populations were discovered only recently, little can be concluded about population trends of *H. dacotae* in Saskatchewan.

In the United States, *H. dacotae* was last seen in Iowa in 1992 and is now presumed to be extirpated from that state (Schlicht and Orwig 1998). In Minnesota, seven out of the 63 known occurrences have become extirpated (including in two counties) since their discovery (Cochrane and Delphey 2002). Most of the extant sites are vulnerable and without any land protection. Since the 1980s and early 1990s, the skipper has been extirpated from eleven of the 43 previously known sites in North Dakota. Most of these populations were lost when prairie habitat was converted to row crops or degraded by heavy grazing, invasion of exotic weeds (and their control), and fire management on public lands (Royer and Royer 1997). Currently, none of the populations in North Dakota may be secure (Cochrane and Delphey 2002). In South Dakota, five of the 53 known populations have become extirpated, three since the early 1990s. However, several of the 16 population complexes appear to be secure (Cochrane and Delphey 2002).

Protection/ownership

Nearly all sites where *H. dacotae* exists in Manitoba are on privately owned land. Most sites are currently either not being used for any apparent agricultural purposes or are being used for hay. Those that are used for hay appear to be mowed late in the summer, either annually or during alternate years. The populations of the skipper appear to be doing well at these sites. One *H. dacotae* site is currently protected in the 2,200-ha Tall-grass Prairie Preserve through the Critical Wildlife Habitat Program. Although this skipper was present in low numbers at the preserve in 2000, it was not found at this site during 2002.

Three of the known localities in Saskatchewan are on private land. Part of the site near Oxbow is on private land and part on land owned by the regional municipality (Bow Valley Regional Park).

BIOLOGY

General

Each life history stage of *H. dacotae* has different resource and microhabitat requirements.

Adult activity period

H. dacotae has only one generation per year. Adults are active for only about three to five weeks at a given locality (McCabe 1981, Dana 1991). According to McCabe (1981), males and females of *H. dacotae* emerge at about the same time. However, in a study by Dana (1991), *H. dacotae* males began emerging about 5 days earlier than females under field conditions. The delay was expected as the duration of post diapause development is longer in female larvae than in males (Dana 1991).

In Canada, adults have been collected from June 23 to July 29. Most collection records are between June 27 and July 8 (CNC collection database, Manitoba Conservation, Biological and Conservation Data System data, Hooper, pers. com., 2002). During 2002, in the inter-lake region near Lundar, the first adults (all freshly emerged males) were observed on July 2. On July 6, 2002, freshly emerged females were present, but the male:female sex ratio (13:5) favored males, suggesting that peak flight had not been reached. Both sexes were common by July 8, but females were still out-numbered by males 3:1, suggesting that protandry occurs in this species in Manitoba. There is, however, considerable overlap in emergence of the two sexes. *H. dacotae* was probably at peak flight at the Griswold site in western Manitoba on July 10, 2002, as a 50:50 sex ratio was observed there.

Dana (1991) estimated the potential adult life span of *H. dacotae* in nature to be about three weeks. One adult was recaptured 19 days after the initial capture in a mark-release-recapture experiment on a Minnesota prairie. Residency (residence on site before death or emigration) was estimated to be 3 to 10 days (Dana 1991).

Adult food resources

Access to nectar is important to *H. dacotae* and other species of butterflies. Nectar provides adults with an energy source and water, and allows females to attain maximal fecundity (Murphy *et al.* 1983).

In wet-mesic tall-grass prairie sites in Manitoba, *H. dacotae* were most frequently observed using *R. serotina*, *L. philadelphicum*, and *C. rotunifolia* as nectar sources. Adults fed from underneath the flower head on *L. philadelphicam* and were often difficult to observe. Dogbane, *Apocynum* sp., was commonly used at two sites near Lundar. In Saskatchewan, *H. dacotae* most commonly used Purple Coneflower, *E. angustifolia*. One or more of these nectar sources were common to very common at sites where *H. dacotae* was common.

In North Dakota, a variety of flowers, mostly members of the Family Compositae, are used as nectar sources by *H. dacotae*. Among these were Long-headed Coneflower, *Ratibida columnifera* (Nutt.), Fleabane, *Erigeron strigosus* Muhl., *E. angustifolia*, Gaillardia, *Gaillardia aristata* Pursh, *R. serotina*, *C. rotundifolia* and Toothed-leaved Primrose, *Oenothera serrulata* Nutt. (McCabe 1981). In a dry-mesic tall-grass-to-mid-grass prairie site in Minnesota, 25 species of flowers were used by *H. dacotae* (Dana 1991). Nearly 90% of all flower visitations were, however, to *E. angustifolia*, *Verbena stricta*, *Astragalus adsurgens* and *Oxytropis lambertii*, with *E. angustifolia* being the most important nectar source at this site. *H. dacotae* is probably opportunistic, foraging on the species of flowers that are most profitable at a given site.

Courtship behaviour

Little data is available on mating behavior of *H. dacotae* in Canada. However, detailed descriptions of courtship behaviour of this species are provided by McCabe (1981) and Dana (1991) from populations in North Dakota and Minnesota, respectively. The mating system of *H. dacotae* appears to be a form of scramble competition polygyny (Dana 1991). Mate-seeking behaviour dominates the daily flight period of males (Dana 1991).

Courtship is of the waiting-perching-pursuit type. Males often perch on a high vantage point above the grass canopy, such as the flower heads of composites, and pursue any insect that flies nearby (McCabe 1981, Dana 1991). In hilly terrain, males often perch on the leeward side of slopes and hills (McCabe 1981, Layberrry et al. 1998). Often aggregations of up to 100 or more individuals gather in areas on the windward side of these hills, especially where nectar sources are common (McCabe 1981). In Saskatchewan, males perched on hillsides as well as on the tops of the hills and ridges, often on the flower heads of *E. angustifolia*. However, on hill tops where the grasses were often short and sparse, males often perched on bare soil or short grasses.

The wet-mesic tall-grass prairie sites in Manitoba have little relief. Within the wet-mesic prairies, males and females were almost exclusively found in the slightly higher, drier areas, usually where the grasses were shorter (10-15 cm high) than in surrounding areas and where nectar sources were more abundant. Adults were rarely found in the lower, wetter areas of the prairies. Males often perched on the flowers of *R. serotina* and *Z. elegans*, but often also perched on the short grasses and even on bare soil. Adults (both males and females) appeared to be more common in prairies that had extensive areas with shorter grasses on the higher ground than at sites where tall grasses were dominant. As many as 59 individuals (42 males, 17 females) were counted in a 15-min period at one prairie site east of Lundar with extensive areas of shorter grasses. In prairies with a late fall mowing regime, more extensive areas with short grasses often occur on the higher ground than in un-mowed sites, and adults of *H. dacotae* were often common on these mowed prairies. Adults were also frequently very common in smaller sections of prairie partially surrounded by aspen groves. These areas may benefit mating behavior because they are more protected from the wind.

More studies are needed to examine the relationship between grass height and *H. dacotae* abundance in the wet-mesic tall-grass prairies of Manitoba.

When a male *H. dacotae* encounters another male *H. dacotae* during the initial pursuit, the pursuit often develops into an aerial engagement with the two whirling about each other at two or three meters above the ground (Dana 1991). Other males may engage the pair, and then all will separate and each will fly to a nearby perch, often different from the original perch. There is little evidence that males return to the same perch, as would be typical of territorial behaviour (Dana 1991).

If the insect the male encounters is a female *H. dacotae*, a different set of behaviours ensues. Perching males attempt to mate with any females that move within their visual range. Typically, the female flies a short distance and lands. The male pursues her, lands and quickly crawls alongside her while curving his abdomen with claspers spread toward the abdomen of the female and attempts to copulate with her (McCabe 1981, Dana 1991). If receptive, the female extends her ovipositor and they mate. If the female rejects the male, she holds her abdomen between closed wings and periodically jerks her wings forward. The male may make a few additional attempts to mate, and if unsuccessful, flies to a nectar source and feeds before going to a perch (McCabe 1981, Dana 1991).

Pheromones contained in the androconial particles in the stigmata of males probably play a role in courtship and as a species isolating mechanism (Dana 1991). Most mating attempts take place during the afternoon between 14:00 and 16:00 h (Dana 1991). Mating pairs remain quiescent within the vegetation, and the duration of copulation is about 45 min. If disturbed, the pair may take flight and travel several meters in a direct flight pattern. The female is the carrier in *H. dacotae* (Dana 1991).

Females often mate within a day or two of adult eclosion. Both sexes may mate more than once during their life span, but a single mating is more common for females (based on spermatophore counts) (McCabe 1981, Dana 1991). When a second mating does occur, it probably takes place shortly after the first mating before the females becomes refractory (Dana 1991).

Oviposition behaviour and fecundity

Females begin to lay eggs shortly after mating and continue ovipositing throughout their life span, which may be up to four weeks (McCabe 1981). Twenty to thirty eggs are laid daily during the first two days after adult emergence, then daily egg production declines linearly to a few eggs per day two weeks after emergence (Dana 1991). Approximately 50% of eggs are laid during the first week and 90% by the end of the second week. Potential maximum life-time fecundity ranges from 180 to 250 eggs per female (Dana 1991).

Eggs are laid singly to the underside of leaves or the upper surface of erect grass blades, usually one to four centimetres above the soil surface within the grass canopy

(Dana 1991). Females fly slowly above the grass canopy and land on bare spots before crawling into the grasses. After the female lays an egg, she flies to a new site. Oviposition occurs throughout the day (Dana 1991).

In the U.S.A., female *H. dacotae* laid eggs on a wide variety of grasses and forbs (McCabe 1981, Dana 1991). In a study at the Hole-in-the-Mountain Prairie in Minnesota, females oviposited on five species of grasses and 13 species of forbs (Dana 1991). The most common grasses used for oviposition, in decreasing order of usage, were *A. scoparius, A. gerardii, Bouteloua curtipendula, S. heterolepis* and Spear Grass, *Stipa spartea* Trin. This contrasts with the findings of McCabe and Post (1977) who reported that eggs were typically laid on leaves of broad-leaved plants in North Dakota. Dana (1991) suggests that females will lay eggs on any surface as long as it is smooth and wide enough to allow the egg to adhere to it. In some cases, the plants on which eggs are laid are also larval host plants, but in many cases they are not. However, eggs are usually laid close to larval hosts (Dana 1991).

Larval resources

H. dacotae larvae use a variety of grass species in nature. Under natural field conditions in Minnesota, larvae fed mostly on *A. scoparius, A. gerardii, B. curtipendula, and S. heterolepis*. Secondary hosts were *Dichanthelium wilcoxianum, Poa pratensis* L. and rarely *Carex heliophila* (Dana 1991). Other common grasses, like *Koehleria cristata* (L.) Pers. and *S. spartea*, were not eaten in the wild, but were consumed in experimental no-choice conditions (McCabe 1981, Dana 1991). Larvae generally fed on all grass species close to their larval shelters, except on the avoided species (Dana 1991).

The preferred hosts of *H. dacotae* are bunch grasses, such as Little Bluestem, *A. scoparius* and *S. heterolepis*. All these grasses have a dense cluster of erect blades and a mass of persistent basal material that remains edible throughout the summer and into the fall. MacNeill (1964) suggests that these grasses have an architecture that makes them ideal for shelter construction by the larvae and provide a readily available food source close to the shelter. Although other species of grasses can be eaten by the larvae, some may not be suitable because of different architecture (too tall for example) or summer senescence (Dana 1991). The non-native *P. pratensis* and Smooth Brome Grass, *Bromus inermis* Leyess, for example, have a mid-summer senescence or dormancy, making them unsuitable for the larvae of *H. dacotae* in the latter part of the summer and in early fall.

Larval development

The eggs of *H. dacotae* hatch within 7-20 days (10 days on average), depending on temperature (McCabe 1981, Dana 1991). *H. dacotae* has six or seven larval instars or stages. Each of the first three larval stages lasts between 8 and 18 days under field conditions. The duration of the fourth instar is between 16 and 35 days (Dana 1991). The larvae enter an obligatory diapause during either the fourth or fifth instar (usually in

October). Most individuals entered diapause in the fifth instar under field conditions in Minnesota (Dana 1991). In a study in North Dakota, however, the majority of larvae of *H. dacotae* entered diapause during the fourth instar (McCabe 1981). Dana (1991) suggests that the difference may be related to the higher latitude of North Dakota where there is a shorter average interval between completion of fourth instar and onset of cold weather. In Minnesota, larvae complete the fourth instar well before the onset of cool weather and thus have sufficient time to enter the subsequent instar and feed prior to entering diapause. Presumably, *H. dacotae* enters diapause in the fourth instar in Manitoba as well. During the subsequent spring, the fourth or fifth instar larvae molt shortly after feeding resumes. The next two instars (fifth and sixth or sixth and seventh) last 14-19 days and 15-21 days, respectively. Once feeding is completed, the last instar larvae enter the pupal stage, which lasts 13 to 19 days under natural conditions (Dana 1991).

Larval behaviour

Typically, newly eclosed larvae of *H. dacotae* first eat the chorion, crawl down to the surface of the soil (usually within a clump of one of the bunch grasses, such as *A. scoparius*), web small pieces of detritus together at or below the soil surface, and then feed from the shelter. Second, third, fourth and fifth instar larvae construct steeply angled, tubular chambers within a grass clump at or (more frequently) entirely below the soil surface (Dana 1991). The chambers are lined with silk and grass stems. During development, two to three progressively larger shelters are produced. After diapause, the larvae produce elongated horizontal shelters on the soil surface, often partially concealed by the basal material of the grass clump (Dana 1991). Pupation occurs in newly constructed chambers. Fully-grown larvae have a white glandular patch on the ventral portions of abdominal segments seven and eight. The patch contains a waxy hydrofuge (water repellent) substance. Prior to pupation, the larvae distribute this waxy material throughout the pupal chamber (McCabe 1981, Dana 1991). This substance may protect the larvae from the effects of high humidity, which may be an important factor limiting the survival of the skipper (MacNeill 1964).

In nature, the larvae often forage for food outside their chambers, but feeding takes place within the chambers (Dana 1991). The larvae leave their chambers, cut off and remove grass blade segments, carry them back to their chambers, and feed on them. Most feeding may take place at night (McCabe 1981, Dana 1991). The larvae appear to forage on those species of grasses that are in close proximity to the shelters.

Natural mortality factors

One egg parasitoid, *Ooencyrtus* sp. (Encyrtidae: Hymenoptera) has been reared from field collected ova of *H. dacotae* in Minnesota, and ants have also been observed seizing wandering larvae (Dana 1991). Predation on the Dakota Skipper by ambush bugs, *Phymata* sp. (Hemiptera: Phymatidae), flower spiders, *Misumena vatia* (Clerck) and *Misumenops carletonicus* Dendale & Redner (Aranaea: Thomisidae), and various orb spiders has been observed in Minnesota and North Dakota (McCabe 1981, Dana

1991). Ambush Bugs and flower spiders are often found on nectar sources frequently used by the Dakota Skipper. Both are effective predators as they are cryptically colored to match the flowers they rest on and ambush any insects that land on the flowers. Interestingly, these predators were rarely found on the flowers of one of the main nectar sources (*C. rotundifolia*) of *H. dacotae* in North Dakota (McCabe 1981). Orb weaver spiders were less effective predators of young adult *H. dacotae*, which can break from the webbing. Old, worn adults, however, were often less successful in breaking away from the webs (McCabe 1981). Other potential predators include robber flies (Asilidae), dragonflies and birds. However, few cases of predation by these taxa on *H. dacotae* have been observed (McCabe 1981). Bacterial septicemia may be an important mortality factor for *Hesperia* (MacNeill 1964).

Population dynamics

At any given site in North Dakota and Minnesota, population numbers of *H. dacotae* appeared to be very stable from year to year as long as the habitat remained undisturbed. No significant year-to-year population fluctuations were reported at sites where populations have been monitored in successive years (McCabe 1981, Dana 1991, 1997), although Dana (1997) suggests that significant year-to-year fluctuations in population size are possible. No data on long-term population trends are available for any populations of *H. dacotae* in Manitoba or Saskatchewan.

Movements/dispersal

Little information is available on the dispersal of *H. dacotae* in Canada or the United States. In a mark-release-recapture experiment at the Hole-in-the-Mountain preserve in Minnesota, marked adults moved across 200 m of unsuitable habitat between two sections of prairie (Dana 1991). Dana (1991) estimated average adult movements of about 300 m over a three- to seven-day period. Dakota Skipper experts interviewed by Cohrane and Delphey (2002) thought it was unlikely that *H. dacotae* would move more than one kilometre across non-native prairie habitat (crop fields or pastureland) to another prairie patch. Royer and Marrone (1992) also suggested that *H. dacotae* were unlikely to disperse far from their native prairie habitats. Additional studies are required to examine the potential long-range dispersal capabilities of this species.

Interspecific interactions

At most sites in Manitoba and Saskatchewan, *H. dacotae* far outnumbered other species of butterflies, and at some sites it was the only species observed. The two most common species of skippers at most *H. dacotae* sites were *Oarisma garita* (Reakirt) and *P. mystic*. Few interactions between *H. dacotae* and other species of butterflies were observed at most. Occasionally, male *H. dacotae* pursued a skipper of another species, but the pursuits were short. Most of these interactions were with *P. mystic*, which often occurred in the adjacent wetter sections of the prairies. It is unlikely that there is any competition for larval or nectar food resources among these species of butterflies.

Adaptability

The Dakota Skipper is extremely susceptible to habitat changes and is rarely found in prairie habitats that have been altered (McCabe 1981). Although the immature stages and adults can use a variety of species of plants for food and reproduction, they appear to be restricted to using species associated with undisturbed prairie habitats. Alteration of this native plant community results in the loss of critical resources for the skipper, which is unlikely to move to new prairie habitats that are more than one kilometre away from the original habitat (Dana 1991, Royer and Marrone 1992). The poor dispersal capabilities and dependence on a specific suite of hostplant species make *H. dacotae* especially susceptible to habitat degradation, particularly when remnant populations are widely dispersed.

POPULATION SIZES AND TRENDS

No data are available on population sizes and trends at any of the sites where *H. dacotae* is currently known to exist in Canada (in the inter-lake and Griswold areas of Manitoba and in southeastern Saskatchewan). Although crude, the first population estimates were made in 2002 at most sites where *H. dacotae* was found in Canada using the following method. Preliminary survey work on a couple of prairies near Lundar, Manitoba, revealed that the density of *H. dacotae* varied greatly within a given prairie, depending on the plant community. Adults were almost invariably associated with higher, drier sections of the prairies, and no adults were observed in the lower, wetter areas. Because of the considerable number of prairies and their size, only small sections of each prairie could be surveyed. *H. dacotae* were counted in one to nine 0.5-ha sections of the drier prairie within each prairie surveyed. Counts were made while walking at a slow pace in a zig-zag path through the entire plot. It usually took about 15-20 minutes to count the adults in a 0.5-ha section of prairie. A very rough population estimate was made based on the density of adults observed in the drier areas and the estimated proportion of the prairie with this kind of habitat [(mean number of adults per hectare in the 0.5 hectare sections counted) x (estimated proportion of drier prairie) x (estimated size of prairie)]. The size of the prairies was estimated visually with the aid of landmarks and topographic maps.

During 2002, 436 adults (339 males, 97 females) of *H. dacotae* were counted at 17 localities (plus 29 sub-sites) in the inter-lake region of Manitoba. The prairies at these sites varied greatly in size from 0.5 ha to 500 ha in some of the larger prairie complexes. The total area occupied by *H. dacotae* in Manitoba was estimated at around 2,700 ha. The estimated number of adults per locality varied considerably, from 15 individuals at a small one-hectare prairie east of St. Laurent, to 2,000 individuals in a 500-hectare series of prairies south of Lundar. The density of *H. dacotae* also varied considerably within a given prairie. At one 250-hectare prairie east of Lundar, *H. dacotae* was counted in nine sections of the prairie. Adults were usually present only in the drier areas of the prairie dominated by bluestem grasses and varying densities of *L. philadelphicum*, *Z. elegans*, *C. rotundifolia* and *R. serotina*. The densities of adults in

each of the nine sections were 24, 8, 18, 6, 4, 24, 4, 118, and 6 individuals per hectare (average density = 23.5 individuals/ha). No adults were observed in the low, wetter sections of the prairie at this locality. The highest density occurred within a two-hectare section of undisturbed prairie containing extensive areas of short bunch grasses. At sites surveyed more intensively, *H. dacotae* was found in less than 25% of the open prairie habitat. The lower, wetter areas appeared to be unsuitable for this skipper.

The total number of *H. dacotae* in the inter-lake region was estimated to be near 12,000 individuals on the dates the survey was done. These estimates, however, need to be viewed with caution. Because average density appears to vary considerably within a given prairie, population numbers may be greatly over- or under-estimated at localities where counts were made at only one or two sub-sites. Surveys were not done at peak flight, and the total seasonal population of reproductive adults was likely higher than the one-day estimates. Dana (1991) estimated that only a third to a fifth of adults in a given population are alive simultaneously. Thus, the total seasonal population of this skipper in the inter-lake region may be between 25,000 and 35,000 individuals. Additional prairies occupied by *H. dacotae* likely exist in the region, which may further increase the population estimates. Additional surveys to locate new populations of *H. dacotae* are needed, and more detailed population estimates should be made at all these sites.

On July 10, 2002, a total of 25 males and 22 females were counted at the 100- and 200-ha sites near Griswold, Manitoba. The population was estimated at around 1,750 individuals on the date of the survey. The total seasonal adult populations may be between 3,000 and 5,000 individuals. However, as noted above, this estimate should be viewed with caution and more detailed population estimates should be done at these sites.

H. dacotae is currently known from three sites (four localities) in Saskatchewan. The prairie near Oxbow covers an area of about 50 ha. The population at this locality was estimated to be at least 250 individuals. No estimates are available on the population size and area of the prairies at the other three localities in Saskatchewan.

Similar densities of *H. dacotae* have been observed at a number of other wet-mesic tall-grass to dry-mesic mixed-grass prairies in the U.S.A. Royer and Marrone (1992) reported densities of 40 individuals per hectare in wet-mesic bluestem prairies in North Dakota. In the Hole-in-the-Mountain preserve in Minnesota, Dana (1991) found 25 adults per hectare in a 40 ha area at peak seasonal abundance. He estimated that the total seasonal population was 2,000-3,000 adults. These high densities only persist for 7-10 days during the flight season (Dana 1991).

LIMITING FACTORS

H. dacotae is found only in wet-mesic bluestem/tall-grass or dry-mesic mixed-grass (bluestem) prairie habitats. It is extremely susceptible to any habitat changes that

alter the floral and structural components of its preferred habitat (McCabe 1981). Key adult and larval food resources must be present in the habitat for the long-term survival of this species.

Nectar flowers

Regular access by adults to nectar is critical to the survival of adult *H. dacotae*. Nectar provides carbohydrates needed to meet the energetic needs for flight and allows females to attain maximal fecundity (Murphy *et al.* 1983). Without a readily available source of nectar, lifetime fecundity would likely be reduced, thereby reducing the number of potential offspring in the next generation. Nectar also provides water, which may be the most critical resource required for the survival of adult *H. dacotae* in the prairie habitat where free water is often absent (Dana 1991). *Hesperia leonardus pawnee* Dodge inadvertently deprived of water while confined in field cages on a hot windy day died within a few hours (Dana 1991). Regular access to nectar may therefore be critical for the survival of adult *H. dacotae*.

Although *H. dacotae* is a relative generalist, it has preferred nectar species of flowers (Dana 1991). Flower preference varies regionally, in part related to the relative abundance of these species of plants in the habitats where the skipper occurs. Among the preferred species of nectar flowers are the composites, *E. angustifolia* and *R. serotina*. Other important nectar sources for Canadian populations of *H. dacotae* are *L. philadelphicum,* and *C. rotunifolia*. These species are characteristic components of undisturbed native prairie habitats in Canada and the United States.

Larval host plants

Larval *H. dacotae* eat a variety of species of grasses in nature (McCabe 1981, Dana 1991). However, the preferred hosts of *H. dacotae* are bunch grasses, such as Little Bluestem, *A. scoparius* and *S. heterolepis*. All the commonly used host grasses of this skipper are species characteristic of undisturbed native prairie habitats in Canada and the United States.

Mating activity sites

In Manitoba, adult *H. dacotae* are usually found in the drier portions of the prairie and rarely in the lower, wetter sections. Perching males and mating pairs were most commonly observed in areas where short bunch grasses predominated and favorite nectar flowers (*L. philadelphicum*, *C. rotundifolia* and *R. serotina*) were common. These sites were characterized by having large patches of short grasses with little or no tall living or dead, standing grass. Adults appeared to be much less common in portions of the prairies where tall grasses predominated. The presence of patches of short grasses with nectar sources may be important for mating activity of this skipper. More study is needed to address this issue.

THREATS

Conversion of habitat to non-grassland

Since the 1850s, over 99% of the native prairie habitat in North America has been converted to agricultural row crops or plowed and converted to hay fields (Samson and Knopf 1994). Agricultural habitats are completely unsuitable for *H. dacotae*. Many prairie remnants have probably survived because poor soils (often highly alkaline) or steep terrain make them unsuitable for row-crop agriculture (McCabe 1981). Nevertheless, one prairie with a population of *H. dacotae* near Fannystelle has been converted to row crops since 1991, probably because its flat topography made it suitable for conversion to crop production. Nearly all other populations of *H. dacotae* in Manitoba occur on flat terrain, increasing their vulnerability to conversion to crop production, but poor soil conditions may lessen the risk (Kennedy, pers. com. 2002).

Grazing

Tall-grass and especially mixed-grass prairies appear to be very susceptible to the effects of overgrazing (McCabe and Post 1977, Royer and Marrone 1992, Royer and Royer 1998), which reduces or eliminates critical adult nectar sources and removes forage for larvae. Trampling by cattle may kill larvae and cause soil compaction. These factors make the habitat unsuitable for the skipper (McCabe 1981). In Minnesota, grazing cattle reduced skipper numbers in direct proportion to grazing intensity (Dana 1997). Dana (1997) further observed that exotic grasses, such as *P. pratensis* and *B. inermis*, become the major or dominate species in grazed prairies, and native species richness and diversity declines. In the Lundar area of Manitoba, few nectar sources were observed on grazed prairies, and most grasses had been cropped down to 10 cm or less in height. No *H. dacotae* were observed in these prairies. In North Dakota, *H. dacotae* was rarely found on grazed prairies. Important nectar sources, such as *O. serrulata*, *C. rotundifolia*, *R. columnifera* and *E. angustifolia*, are generally eliminated, even by light grazing. The flowers that are often avoided by the skipper (milkweeds) are also avoided by the grazers and remain in these habitats (McCabe 1981).

Although overgrazing can eliminate a population of *H. dacotae* within one year in tall-grass prairies, grazing is not always detrimental (Dana 1991). Light or light rotational grazing in tall-grass prairie can be beneficial by creating areas of mixed-grass vegetation structure preferred by the skipper (Dana 1991). *H. dacotae* was abundant on prairies with light grazing, but absent on adjacent idle prairies (Schlicht 1997).

Haying

Haying may either be detrimental or beneficial to *H. dacotae* populations depending on when in the season it is done. Mowing prairies and removing the cuttings helps to maintain the vegetation structure by preventing or delaying succession to woody plants and reducing the accumulation of litter on the soil. However, if mowing is

done before or during the flight period, the critical adult nectar sources are eliminated and exotic grasses such as *P. pratensis* are favored (McCabe 1981, Royer and Marrone 1992, Dana 1997). This can cause the elimination of *H. dacotae* from the prairie.

In contrast, late season (September into October) mowing reduces the adverse effects created by mowing early and may even be highly beneficial to *H. dacotae* populations (McCabe 1981, Skadsen 1997, Swengel and Swengel 1999). Most populations of this skipper in eastern North and South Dakota are found in prairies with a late season mowing regime (McCabe 1981, Skadsen 1997). In a systematic survey in three states, *H. dacotae* was considerably more abundant in prairies that had been hayed in the fall than in those that were idle, grazed or burned (Swengel and Swengel 1999). The same appears to be true for many of the populations in Manitoba. At least 14 of the 17 sites where *H. dacotae* was found in the Lundar area appeared to be under a late season mowing regime. According to Kennedy (pers. com. 2002), most of these sites are mowed only on alternate years. This in part is because little forage is present earlier in the season. Many of the native grasses of the tall-grass prairies mature later in the season than non-native species. The two sites south of Griswold also appear to be under a late season mowing regime. Several large bales of hay were present on these prairies when the site was visited during 2002. *H. dacotae* were common at most of these sites. Little dead, standing grass was present on mowed sites during the adult flight season compared to idle sites. The absence of dead, standing grass may create better access to nectar sources. Mowing also creates more areas with the shorter grass structure preferred by the skipper for mating activity than usually occur on sites without mowing.

Controlled burning

Wildfires were an important element for sustaining the flora and fauna of native prairies prior to their destruction (Bragg 1995). Now, prescribed or controlled burns are often used by managers to maintain the native grassland structure and floral complexes. These burns differ from wildfires in that remnant prairies are often burned far more frequently (sometimes once every three years), more thoroughly (sometimes border to border), and at times during the season when wildfires would not normally occur (Orwig and Schlicht 1999). Although prescribed burns may be beneficial for maintaining the prairie flora, they may be devastating to certain species of insects. Prescribed burning of isolated prairies can cause local extirpation of certain insect species, especially habitat specialists such as *H. dacotae* and *Oarisma poweshiek* (Parker) (McCabe 1981, Schlicht and Saunders 1994, Swengel 1996, 1998, 2001, Orwig and Schlicht 1999). Prior to the destruction of the prairies, burns were patchy, which allowed re-colonization by skippers of burned sites from adjacent unburned areas (Swengel 1998). Now, there are often no source populations available for re-colonization once a population has been locally extirpated. In Minnesota prairies, significantly lower abundances of *H. dacotae* and other habitat specialists were observed at sites that had been burned than at sites that had been hayed (Swengel and Swengel 1999, Swengel 1996, 1998). Burning may have caused the extirpation of *H. dacotae* from the last location of this species in Iowa (Orwig and Schlicht 1999). Dana (1991) suggested that rotational, controlled, early spring burning might

benefit *H. dacotae* by increasing nectar plant density and reducing high levels of litter that might negatively impact development of the immature stages. It was suggested that early spring burning would have less impact on the larvae than late spring, summer or fall burning, because they would still be within shelters below the soil surface. However, two to four years after early spring burning, the abundance of *H. dacotae* (and several other habitat specialist butterflies) was still lower than pre-burn abundances on several Minnesota reserves (Swengel 1996), showing that burning is a major threat to this species.

H. dacotae was found at Manitoba's Tall-Grass Prairie Preserve as recently as 2000 (Britten, pers. com. 2002). However, despite a fairly intensive survey in 2002, no adults were found at this reserve, and it is possible that *H. dacotae* either no longer exists at this site or is present in very low numbers. Further survey work is required to confirm this. Prescribed, rotational, early spring burning has been the major management practice used to prevent growth of woody vegetation and maintain the native prairie flora in this reserve. However, over 50% of the reserve was burned during the spring of 2002 (a major section of the reserve was burned by an unscheduled wildfire) (Borkowsky, pers. com. 2002). During the 2002 survey, it became very obvious that fewer butterflies were present in the burned sections of the reserve than in unburned areas. Subsequent butterfly counts (15-min counts per site) confirmed this. Butterfly abundance at tall-grass prairie sites (10 sites) burned in the spring of 2002 (two in 2001) was less than 6% of the abundance at sites (seven sites) that had not been burned for two or more years (the mean number of individuals was 2.8 and 46.7, respectively). Species abundance was also lower in the burned than the unburned sites (1.6 and 9.6 species, respectively). This data should be viewed with caution as butterfly abundance was not measured prior to 2002. It is possible that the prescribed spring burning, in conjunction with the unscheduled wildfire, may have contributed to the reduction in numbers of *H. dacotae*. Very little leaf litter was present on the soil surface in areas that had been burned, suggesting that any species of insects that were within the litter layer, or even slightly below the soil surface, had probably been killed by the fire. Additional studies are required to examine the effect of spring burning on butterfly abundance and diversity in tall-grass prairie.

Succession

Prairies that are protected from all activities, such as grazing, mowing or prescribed burns, can rapidly become unsuitable for *H. dacotae* because of the growth of shrubs and taller grasses, accumulation of litter, reduction in nectar sources, and invasion of exotic plants, such as *B. inermis* (McCabe 1981, Dana 1997). A significantly lower abundance of *H. dacotae* was observed on unmanaged prairies compared to sites with fall haying (Swengel and Swengel 1999). No systematic surveys have been done to address this issue for Canadian populations of *H. dacotae*.

It appears that some form of disturbance is required for the persistence of prairie habitat that is appropriate for this skipper. In view of the detrimental effects of prescribed burning, probably the best solution for preventing succession is mowing late in the summer or fall. McCabe (1981) suggests that the optimal time for mowing is in

October. Mowing at this time has no apparent negative impact on the tall grass prairie flora or fauna. The Hook and Bullet Refuge in Minnesota has been maintained in this way for over 50 years (McCabe 1981). Prior to the colonization of the prairies by Europeans, most prairie habitats were maintained by periodic grazing by bison and occasional prairie fires. Since much of the habitat was suitable for *H. dacotae*, adults were able to re-colonize adjacent suitable habitats when forced to leave areas made temporarily unsuitable by grazing or fires. Today, the suitable habitats that remain are too widely separated to allow for re-colonization, and they must be maintained by artificial means (McCabe 1981).

Exotic species

Exotic plants, such as Leafy Spurge, *Euphorbia esula* L., Kentucky Blue Grass, *P. pratensis,* and Smooth Brome, *B. inermis,* are significant threats to native prairie habitats in North America. Once they invade a site they can potentially out-compete and replace the native plants required for the survival of *H. dacotae*. *H. dacotae* has been eliminated from at least one site in North Dakota as a direct result of the invasion of *E. esula* (Royer and Royer 1997). Because of early senescence, *P. pratensis* and *B. inermis* are unsuitable for the larvae of *H. dacotae* (Dana 1991). Grasslands that become dominated by these species cannot support the skipper. Chemical control of *E. esula* often eliminates the nectar sources required by *H. dacotae* and may have caused the extirpation of this skipper from several sites in North Dakota (Royer and Marrone 1992). It is not known how much of a threat these exotic plants pose to prairie habitats and *H. dacotae* in Manitoba.

Habitat fragmentation

H. dacotae formerly existed as essentially a single population throughout much of the almost continuous tall-grass and mixed-grass prairies in the north central plains of North America. Now it occurs as a series of isolated populations throughout much of its range (McCabe 1981, Cochrane and Delphey 2002). Long distance dispersal of this species may be limited to approximately one kilometre (Cochrane and Delphey 2002). Unless source populations exist within one kilometre, it is unlikely that a population eliminated by fire, overgrazing or other causes will be re-founded by immigrants (McCabe 1981, Swengel 1998). In Canada, only three population centres exist, and none are closer than 100 km from each other or from population centres in the United States. There is only a very remote probability that any one of these population centres could be re-founded by natural dispersal after it was eliminated. Small isolated populations of *H. dacotae* are also at a greater risk of becoming extirpated by unusual weather events or other accidental events (Schlicht and Saunders 1994, Hanski *et al.* 1996). The population near Griswold may occur in a large enough area (300 ha) to be relatively secure from extirpation by natural events. At least 17 populations exist in the inter-lake region. A number of these may be connected by dispersal, reducing the risk that they will be eliminated in the near future. However, the risk of extirpation will increase should further fragmentation of the prairie habitats occur in this region.

Collection of natural history specimens

Collection of natural history specimens probably does not currently pose a significant threat to this species based on current population levels and the reproductive potential of this species. Skippers are generally not as popular with most collectors of natural history specimens as other, showier species of butterflies. In Manitoba, it is currently illegal to collect specimens of this species without a scientific permit.

Other threats

The proliferation of large-scale hog farms may pose a significant threat to *H. dacotae* in Manitoba (Duncan, pers. com. 2004). Use of hog manure to fertilize native prairies will likely alter the species composition of the flora and may cause the habitat to become unsuitable for the skipper.

With the continued expansion of agriculture in the area, there may be increased pressures to increase drainage in many of the tall-grass prairies (Duncan, pers. com. 2004). Many of the native prairie sites have extensive wet areas, especially early in the season. Increased drainage may alter the flora of these prairies. In some cases, the increased drainage may benefit *H. dacotae* by expanding the size of the drier sections of the prairie preferred by this skipper.

SPECIAL SIGNIFICANCE OF THE SPECIES

H. dacotae is one of a very small group of specialist butterflies that occurs only in native tall-grass and mixed-grass prairie habitats in Canada. This species now occurs in a series of isolated populations in the United States and Canada. The loss of this species from Canada will be the loss of a significant element of the endangered prairie ecosystem. Studies by Britten and Glasford (2002) indicate that the Manitoba populations of this species likely became isolated from populations to the south a considerable time ago. Based on genetic differences, the populations in Manitoba may have diverged to the level of a subspecies.

EXISTING PROTECTION OR OTHER STATUS

H. dacotae currently has no legal protection in Canada at the national level. However, *H. dacotae* is listed as endangered by the province of Manitoba under its Endangered Species Act. Under this provincial law, it is unlawful to kill, injure, possess, disturb or interfere with species. It is also unlawful to disturb or destroy its habitat or any natural resources it depends on for its life or propagation without a permit. There is currently no legal protection in Saskatchewan.

Globally, the World Conservation Union (IUCN) classifies *H. dacotae* as vulnerable. In the United States, *H. dacotae* receives no federal protection under the

Endangered Species Act. This skipper is listed as endangered in Iowa, threatened in Minnesota, and has no legal protection in either North or South Dakota (Cochrane and Delphey 2002).

SUMMARY OF STATUS REPORT

H. dacotae is found only in tall-grass and upland mixed-grass prairie habitats. It is extremely susceptible to disturbances that alter the floral and structural components of its preferred habitat. This insect probably once occurred throughout much of southern Manitoba and southeastern Saskatchewan. Over 99% of this habitat has been converted to row crops or lost to over-grazing, and only about 50 km^2 of tall-grass prairie now remain. The Canadian distribution of *H. dacotae* is currently highly fragmented, and the species occurs in only three or four small areas of the country. The largest and possibly most secure series of populations occurs in the inter-lake region of Manitoba northwest of Winnipeg. Grazing and fire were required elements for the long-term persistence of the prairie ecosystem in the past. Because of the highly fragmented nature of the populations of *H. dacotae*, these same elements have become major threats to the long-term survival of this species.

TECHNICAL SUMMARY

Hesperia dacotae
Dakota Skipper — Hespérie du Dakota
Range of Occurrence in Canada: Manitoba, Saskatchewan

Extent and Area Information	
• *Extent of occurrence (EO)(km²)*	64,000 km²
• *Specify trend in EO*	Decline
• *Are there extreme fluctuations in EO?*	None recent
• *Area of occupancy (AO) (km²)*	30-50 km²
• *Specify trend in AO*	Decline
• *Are there extreme fluctuations in AO?*	Unknown
• *Number of known or inferred current locations*	23 locations in 3 or 4 population centres
• *Specify trend in #*	Decline
• *Are there extreme fluctuations in number of locations?*	None recent
• *Specify trend in area, extent or quality of habitat*	Habitat is being degraded at some localities. A loss of at least one prairie has occurred during the past 10 years.
Population Information	
• *Generation time (average age of parents in the population)*	One year
• *Number of mature individuals*	15,000 to 40,000
• *Total population trend:*	Declined over past 10-15 years
• *% decline over the last/next 10 years or 3 generations.*	Decline has occurred, but % decline cannot be estimated during past 10 years; additional decline expected.
• *Are there extreme fluctuations in number of mature individuals?*	Not known for Canadian Populations. Populations remain stable from year to year at other sites in the United States.
• *Is the total population severely fragmented?*	Population is fragmented in Canada with little likelihood of gene flow among population centers
• *Specify trend in number of populations*	Decline
• *Are there extreme fluctuations in number of populations?*	No
List populations with number of mature individuals in each: - Inter-lake area, 12,000 to 35,000 - Griswold area, 1,700 to 5,000 - Tall-grass Prairie Preserve, may be extirpated - southeastern Saskatchewan (at least 250 at one site and no estimates for populations at other sites)	

Threats (actual or imminent threats to populations or habitats)	
Habitat loss and degradation due to: Conversion of habitat to row crops Grazing Early summer or mid summer haying Controlled burning Succession Invasion by exotic species and their control Habitat fragmentation Proliferation of hog farms	
Rescue Effect (immigration from an outside source)	Low
Status of outside population(s)? **USA:** Threatened or endangered, in decline.	
• *Is immigration known or possible?*	Very unlikely from more than a few km
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	Not likely
Quantitative Analysis	**Not performed**
Current Status **COSEWIC:** No previous COSEWIC designation The IUCN lists the Dakota Skipper as globally Vulnerable The skipper is listed as Endangered under Manitoba's Endangered Species Act, Endangered in Iowa, and Threatened in Minnesota	

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric code:** Met criteria for Endangered, B2ab(iii), but was designated Threatened, because it is not at imminent risk of extirpation.
Reasons for Designation: This butterfly is dependent on native tall-grass and mixed-grass prairie, a habitat that has suffered enormous historic losses, and the butterfly's populations have likely undergone similar declines. Current remnants of native prairie are generally not highly threatened as they are mostly unsuitable for agriculture, but some habitat loss and fragmentation continue. The butterfly is very sensitive to conversion of prairie remnants to cropland, spring and summer haying, heavy grazing, controlled burns and increased pressures to drain natural sites. Although the current population of this butterfly numbers 28,500 - 40,500 individuals, these occur in only three or four disjunct populations. The long-term persistence of the butterfly is dependent on appropriate management of its habitat, most of which is privately owned.	

Applicability of Criteria

Criterion A (Declining Total Population):
- there is insufficient data to be able to quantify decline.

Criterion B (Small Distribution, and Decline or Fluctuation):

- the EO is >20,000 km^2 (~64,000 km^2);
- the AO is << 500 km^2 (30-50 km^2) (B2);
- the population is severely fragmented (a) even though the species occurs at approximately 23 locations in 3-4 population centres between which there is believed to be no, or very little, genetic exchange;
- declines in habitat are not well documented, but some habitat patches continue to be lost and degraded [b(iii)].
- the population is unlikely to undergo extreme fluctuations in numbers of mature individuals.

Criterion C (Small Total Population Size and Decline):
- the number of mature individuals is >10,000 (15,000-40,000).

Criterion D (Very Small Population or Restricted Distribution):
- the total number of mature individuals is >1,000;
- the AO is >20 km^2 and the species occurs at >5 locations.

Criterion E (Quantitative Analysis):
- the available information is insufficient to do a quantitative analysis of the probability of extinction.

ACKNOWLEDGEMENTS

I wish to thank the Canadian Wildlife Service, Environment Canada, for funding this work. Jason Greenall (Manitoba Wildlife) and Annabelle Jessop (Canadian National Collection) provided collection records for the Dakota Skipper. I thank Reverend Ronald Hooper for supplying information and new records for this species from Saskatchewan. Access to collections was provided by Donald Lafontaine (Canadian National Collection), Robert Roughly (University of Manitoba) and Robert Robbins (Smithsonian Institution). Invaluable information on the Dakota Skipper was graciously supplied by Paul Catling, Christie Borkowsky, Hugh Britten, Robert Dana, Philip Delphey, Lance Kennedy, Timothy McCabe, William Preston, Ronald Royer, Stephen Spomer, Scott and Ann Swengel, Peggy Westorpe and Richard Westwood. James Duncan and William Watkins (Manitoba Conservation) provided assistance in securing the necessary collection permits, maps of Manitoba, and other invaluable assistance with this project. I thank Chantel Rheault (Manitoba Conservation) for her field assistance. I thank Alain Filion (Canadian Wildlife Service) for creating the maps used in this report. Theresa Fowler served as coordinator in the preparation of this report. She edited the report and, along with other members of the Lepidoptera Specialist Group of COSEWIC, reviewed the report and provided comments. I thank Jon Sweeney and Chris McQuarrie (Canadian Forest Service) for assistance and use of their digital camera, and Marie Andreé Giguère for assistance in preparing the figures.

LITERATURE CITED

Bragg, T.B. 1995. The physical environment of Great Plains grasslands. Pp. 49-81 in Joerm, A. and K.H. Keeler. The Changing Prairie: North American Grasslands. Oxford University Press, Oxford, UK. 244 pp.

Britten, N.B., and J.W. Glasford. 2002. Genetic population structure of the Dakota skipper (Lepidoptera: *Hesperia dacotae*): A North American native prairie obligate. Conservation Genetics 3:363-374.

Catling, P.M., and V.R. Brownell. 1987. New and significant vascular plant records for Manitoba. The Canadian Field-Naturalist 101:437-439.

Catling, P.M., and J.D. Lafontaine. 1986. First documented record of *Oarisma powesheik* (Lepidoptera, Hesperiidae) in Canada. The Great Lakes Entomologists 19: 63-66.

Cochrane, J.F., and P. Delphey. 2002. Status assessment and conservation guidelines. Dakota skipper, *Hesperia dacotae* (Skinner) (Lepidoptera: Hesperiidae), Iowa, Minnesota, North Dakota, South Dakota, Manitoba, and Saskatchewan. Department of the Interior, U.S. Fish & Wildlife Service. April 2002. 77 pp.

Dana, R.P. 1991. Conservation management of the prairie skippers *Hesperia dacotae* and *Hesperia ottoe*: basic biology and threat of mortality during prescribed burning in spring. Minnesota Agricultural Experiment Station Bulletin 594-1991 (AD-SB-5511-S). University of Minnesota, St. Paul. 63 pp.

Dana, R.P. 1997. Characterization of three Dakota skipper sites in Minnesota. Unpublished report, Minnesota Department of Natural Resources, Natural Heritage and Nongame Research Program, St. Paul, MN. December, 22, 1997. 17+pp.

Hanski, I.A., A. Moilanen, and M. Gyllenberg. 1996. Minimum viable metapopulation size. American Naturalists 147:527-541.

Hooper, R.R. 2003. Dakota skipper (*Hesperia dacotae*) in Saskatchewan. Blue Jay 61:124-125.

Howe, W.H. 1975. The Butterflies of North America. Doubleday & Company, Inc. Garden City, New York. xiii + 633 pp.

Layberry, R.A., P.W. Hall, and J.D. Lafontaine. 1998. The Butterflies of Canada. University of Toronto Press, Toronto, Ontario. 280 pp.

MacNeill, C.D. 1964. The skippers of the genus *Hesperia* in western North America, with special reference to California (Lepidoptera: Hesperiidae). Univ. Calif. Publ. Entomol. 35:1-230.

McCabe, T.L. 1981. The Dakota skipper, *Hesperia dacotae* (Skinner): range and biology, with special reference to North Dakota. Journal of the Lepidopterists' Society 35:179-193.

McCabe, T.L., and R.L. Post. 1977. Skippers (Hesperoidea) of North Dakota. North Dakota Insects Pub. No. 11, North Dakota State University, Agricultural Experimental Station, Fargo, North Dakota.

Murphy, D.D., A.E. Launer, and P.R. Ehrlich. 1983. The role of adult feeding in egg production and population dynamics of the checkerspot butterfly *Euphydryas editha*. Oecologia 56:257-263.

Opler, P.A., and G.O. Krizek. 1984. Butterflies East of the Great Plains: An Illustrated Natural History. The Johns Hopkins University Press, Baltimore, Maryland. xvii + 294 pp.

Orwig, T., and D. Schlicht. 1999. The last of the Iowa skippers. American Butterflies. 7(1):4-12.

Royer, R.A., and G.M. Marrone. 1992. Conservation status of the Dakota skipper (*Hesperia dacotae*) in North and South Dakota. Unpublished report, U.S. Fish and Wildlfie Service, Denver, CO. 15 March 1992. 44+pp.

Royer, R.A. and M.R. Royer. 1997. A final report on conservation status of the Dakota skipper [*Hesperia dacotae* (Skinner 1911)] in the State of North Dakota during the 1996 and 1997 flights, including observations on its potential recovery in the state. Unpublished report, North Dakota Department of Parks and Recreation, Bismark, ND. September 30, 1997. 26+pp.

Royer, R.A., and M.R. Royer. 1998. Report on an inventory of habitat and occurrence of Dakota skipper [*Hesperia dacotae* (Skinner 1911)] in the Towner-Karlsruhe Habitat Complex (McHenry County, North Dakota) during 1998. Unpublished report, Division of Science, Minot State University, and U.S. Fish and Wildlfie Service, St. Paul, MN, December 1, 1998. 25+pp.

Sampson, F., and F. Knopf. 1994. Prairie conservation in North America. Bioscience (6):418-421.

Schlicht, D. 1997. Population monitoring for prairie butterflies in Minnestota. Unpublished report, Minnesota Department of Natural Resources, Natural Heritage and Nongame Research Program, St. Paul, MN. March 30, 1997. 26+pp.

Schlicht, D.W., and T.T. Orwig. 1998. The status of Iowa's Lepidoptera. Journal of the Iowa Academy of Sciences 105:82-88.

Schlicht, D. and M. Saunders. 1994. Completion of status surveys for the Dakota skipper (*Hesperia dacotae*) and the Poweshiek skipper (*Oarisma poweshiek*) in Minnesota (with additional data on the regal fritillary (*Speyeria idalia*). Unpublished report, Minnesota Department of Natural Resources, Natural Heritage and Nongame Research Program, St. Paul, MN. July 29, 1994. 22+pp.

Sheviak, C. 1974. An introduction to the ecology of the Illinois Orchidaceae. Illinois State Museum Scientific Papers 14, 89 pp.

Skadsen, D.R. 1997. A Report on the results of a survey for Dakota skipper [*Hesperia dacotae*] (Skinner 1911)] in northeast South Dakota during 1996 and 1997 flight periods, Unpublished report, South Dakota Department of Game, Fish, and Parks. Pierre, SD, December 31, 1997. 34+pp.

Skinner, H. 1911. New species or subspecies of North American butterflies. (Lepid.). Entomological News. 22(9):412-413.

Swengel, A.B. 1996. Effects of fire and hay management on abundance of prairie butterflies. Biological Conservation. 76-73-85.

Swengel, A.B. 1998. Effects of management on butterfly abundance in tallgrass prairie and pine barrens. Biological Conservation. 83:77-89.

Swengel, A.B. 2001. A literature review of insect responses to fire, compared to other conservation managements of open habitat. Biodiversity and Conservation 10:1141-1169.

Swengel, A.B., and A.R. Swengel. 1999. Observations of prairie skippers (*Oarisma poweshiek. Hesperia dacotae, H. ottoe, H. leonardus pawnee,* and *Atrytone arogos iowa*) (Lepidoptera: Hesperiidae) in Iowa, Minnesota, and North Dakota during 1988-1997. The Great Lakes Entomologist. 32(4):267-292.

BIOGRAPHICAL SUMMARY OF THE REPORT WRITER

Reginald P. Webster is currently working as a private consultant. He holds a PhD degree in Entomology from the Department of Entomology, Michigan State University. He has authored or co-authored over 20 scientific publications, including recent papers on the life history of the endangered Maritime Ringlet butterfly and a description of a new species of moth. He has also authored numerous reports on the biology, ecology and population structure of the Maritime Ringlet. He taught courses in Population Biology and Ethology at the University of New Brunswick. Since 1999, Dr. Webster has been doing surveys of rare and endangered butterflies for the Maine Department of Inland Fisheries & Wildlife. During the past 10 years, he has been conducting inventories of butterflies, moths and selected families of beetles (mostly Carabidae) at several sites in New Brunswick. He is currently a member of the Lepidoptera Specialist Subcommittee of COSEWIC.

AUTHORITIES CONSULTED

Borkowsky, Christie. July 2002. Prairie Technician, Critical Wildlfie Habitat Program, Box 24, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3,

Britton, Hugh. November 2002. Associate Professor, Department of Biology, University of South Dakota, Vermillion, SD 57069.

Catling, Paul. February 2002. Research Scientist and Curator, and Adjunct Professor (University of Ottawa), Eastern Cereal and Oilseed Research Centre, Biological Resources Program, Agriculture and Agri-food Canada, Research Branch, Wm. Saunders Bldg., Central Experimental Farm, Ottawa, Ontario.

Dana, Robert. November 2002. Natural Heritage and Nonegame Research Program, Minnesota Department of Natural Resources, 500 Lafayette Rd., Box 25, St. Paul, MN 55155-4025.

Delphey, Phillip. October 2002. U.S. Fish and Wildlife Service, Twin Cities Field Office, 4101 E. 80th Street, Bloomington, MN 55425.

Duncan, James. February 2002, January 2004. Acting Chief, Program Manager for the Insect Species Group, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3.

Greenall, Jason. March 2002. Botanist/Ecologist, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3.

Hooper, R.R. March, July, September 2002. Box 757, Fort Qu'Appelle, Saskatchewan S0G 1S0.

Kennedy, Lance. July 2002. Geologist, former farmer. Oak Point, MB.

Jessop, Annabelle. February 2002. Biodiversity Section, Eastern Cereal and Oilseed Research Centre, K.W. Neatby Building, 960 Carling Ave., Ottawa, Ontario.

Lafontaine, J. Donald. October 2001. Research Scientist and Curator of Lepidoptera, Biodiversity Section, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, K.W. Neatby Building, 960 Carling Ave., Ottawa, Ontario.

McCabe, Timothy. March 2002. Curator, New York State Museum, Cultural Education Center, Room 3132, Albany, N.Y. 12230-0001.

Preston, William B. March 2002. Co-author of "The Butterflies of Manitoba", 946 McMillan Avenue, Winnipeg, MB, Canada R3M 0V6.

Roughley, R. March, July 2002. Department of Entomology, University of Manitoba, Winnipeg, MB, Canada R3T 2N2.

Royer, Ronald. October 2002. Division of Science, Minot State University, 500 University Avenue West, Minot, ND 58707.

Spomer, Stephen M. March 2002. University of Nebraska, Lincoln, Institute of Agriculture & Natural Resources, Department of Entomology, 202 Plant Industry, Lincoln, NE 68583-0816

Swengel, Scott. November 2002. 909 Birch St., Baraboo, WI 53913, Tel:(608) 356-9543.

Watkins, William. March, July, October 2002. Program Manager for the Insect Species Group, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3.

Westhorpe, Peggy L. March 2002. Habitat Stewardship Manager, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3.

Westwood, Richard. October 2002. Co-author of "The Butterflies of Manitoba", Center for Forest Interdisciplinary Research & Departments of Biology and Environmental Studies, University of Winnipeg, Winnipeg, MB R3B 2E9.

COLLECTIONS EXAMINED

Canadian National Collection, Ottawa, Ontario (visited during February 2002); the University of Manitoba Collection, Winnipeg, MB (visited during July 2002); and the Smithsonian Institute (National Museum of Natural History), Washington DC (visited during April 2002).